



ICAO ENGINE nvPM EMISSIONS DATA SHEET

SUBSONIC ENGINES

ENGINE IDENTIFICATION: Trent 1000-D3 BYPASS RATIO (-): 9.0
 UNIQUE ID NUMBER: 02P23RR128 PRESSURE RATIO π_{co} (-): 46.0
 COMBUSTOR: Phase5 Tiled
 ENGINE TYPE: TF RATED OUTPUT F_{oo} (kN): 334.7

REGULATORY DATA

| CHARACTERISTIC VALUES: | LTO_{mass}/F_{oo} (mg/kN) | LTO_{num}/F_{oo} (particles/kN) | NVPM MASS CONCENTRATION ($\mu\text{g}/\text{m}^3$) |
|--|--------------------------------|--------------------------------------|---|
| LTO/ F_{oo} AND MAX nvPM _{mass} | 191.5 | 1.70E+15 | 3410 |
| AS % OF CAEP/10 LIMIT | - | - | 87.7 |
| AS % OF CAEP/11 LIMIT (InP) | 55.1 | 40.8 | |
| AS % OF CAEP/11 LIMIT (NT) | 89.5 | 61.2 | |

MEASURED DATA

| MODE | POWER SETTING (% F_{oo}) | TIME minutes | FUEL FLOW kg/s | EMISSIONS INDICES* | | NVPM MASS CONCENTRATION PEAK nvPM _{mass} ($\mu\text{g}/\text{m}^3$) |
|---|--------------------------------|-----------------|-------------------|-------------------------------|-------------------------------------|--|
| | | | | EI _{mass} (mg/kg) | EI _{num} (particles/kg) | |
| TAKE-OFF | 100 | 0.7 | 2.556 | 44.8 | 1.30E+14 | |
| CLIMB OUT | 85 | 2.2 | 2.090 | 76.3 | 2.53E+14 | |
| APPROACH | 30 | 4.0 | 0.687 | 76.5 | 8.68E+14 | |
| IDLE | 7 | 26.0 | 0.256 | 19.1 | 4.59E+14 | |
| LTO TOTAL (kg, mg, number of particles) | | | 947 | 46114 | 4.10E+17 | - |
| NUMBER OF ENGINES | | | | 1 | 1 | 1 |
| NUMBER OF TESTS | | | | 3 | 3 | 3 |
| AVERAGE LTO/ F_{oo} VALUES (mg/kN, particles/kN) | | | | 137.8 | 1.22E+15 | - |
| MAX EI VALUES (mg/kg, particles/kg) AND MAX MASS CONC. ($\mu\text{g}/\text{m}^3$) | | | | 153.0 | 9.28E+14 | 2649 |

* Emissions Indices are corrected for thermophoretic loss and fuel hydrogen content

DATA FOR EMISSIONS INVENTORIES (ESTIMATIONS FOR ENGINE EXIT PLANE VALUES)

| MODE | POWER SETTING (% F_{oo}) | CORRECTED EMISSIONS INDICES | |
|-----------|--------------------------------|----------------------------------|--|
| | | EI _{mass_SL} (mg/kg) | EI _{num_SL} (particles/kg) |
| TAKE-OFF | 100 | 48.0 | 1.76E+14 |
| CLIMB OUT | 85 | 82.4 | 3.61E+14 |
| APPROACH | 30 | 88.2 | 1.94E+15 |
| IDLE | 7 | 23.1 | 9.08E+14 |

AMBIENT CONDITIONS

| | From | To | FUEL | |
|--------------------------------|--------|--------|-------------------------------|-------|
| BAROMETER (kPa) | 100.8 | 101.6 | HEAT OF COMBUSTION (MJ/kg) | 43.34 |
| TEMPERATURE (K) | 287.0 | 292.6 | HYDROGEN CONTENT (%mass) | 13.97 |
| HUMIDITY (kg water/kg dry air) | 0.0080 | 0.0090 | AROMATICS CONTENT (%vol) | 15.9 |
| | | | NAPHTHALENE CONTENT (%vol) | 0.11 |
| | | | SULPHUR CONTENT (ppm by mass) | 300 |

MANUFACTURER: Rolls-Royce plc
 TEST ORGANIZATION: Rolls-Royce plc
 TEST LOCATION: Derby
 TEST DATES: 04/10/2018

REMARKS

1. Certification Report EDNS01000740804
2. Correction of minor error in reported nvPM data
3. The maximum EI_{mass} occurs between 30% and 85% F_{oo}
4. The maximum EI_{num} occurs between 30% and 85% F_{oo}
5. Corrected peak EI number value (fuel correction) since EEDB v30